(No Model.)

E. SLADE & J. S. STONE.

TELEPHONE CIRCUIT.

No. 553,179. Patented Jan. 14, 1896.

Fig. 1.

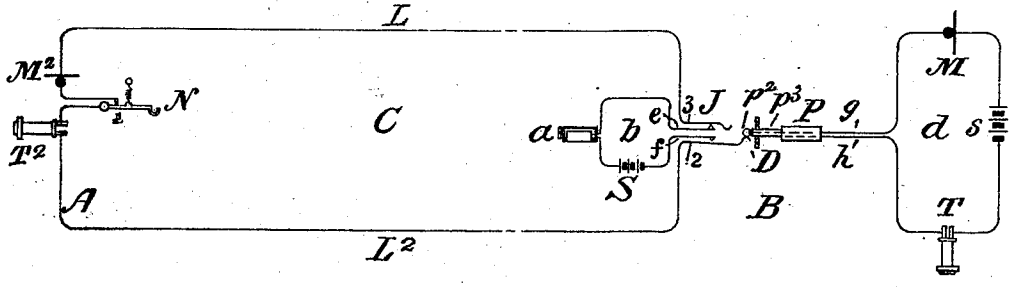


Fig. 2.

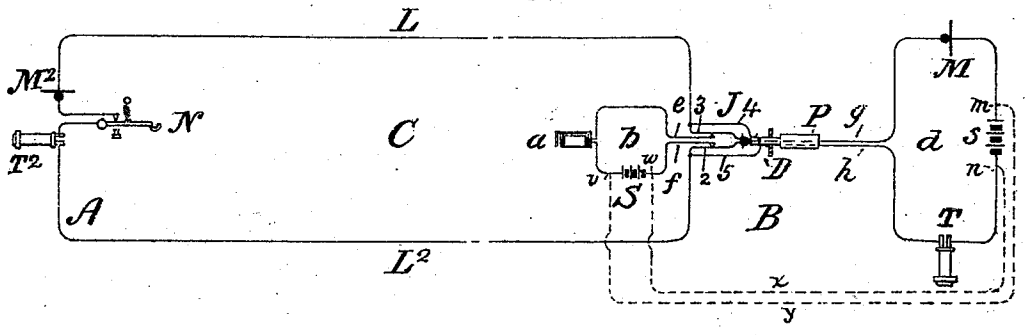


Fig. 3.

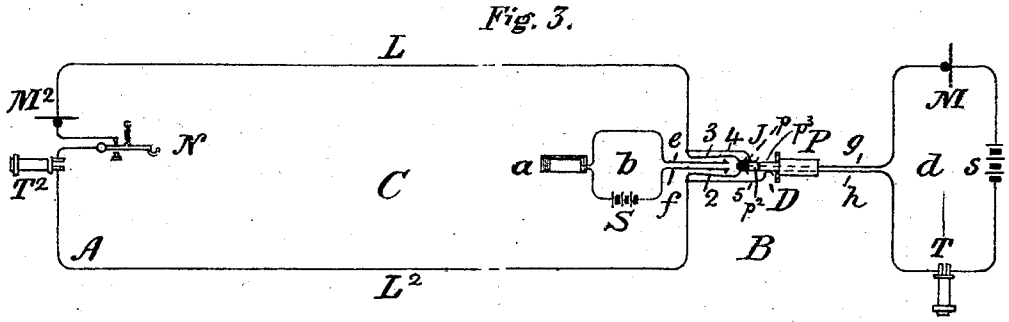
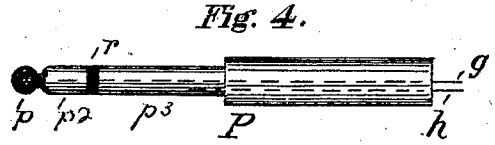


Fig. 4.



Attest.

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TELEPHONE-CIRCUIT.

SPECIFICATION forming part of Letters Patent No. 553,179, dated January 14, 1896.

Application filed July 12, 1895. Serial No. 555,734. (No model.)

To all whom it may concern:

Be it known that we, EDWARD SLADE, residing at Newton, in the county of Middlesex, and JOHN S. STONE, residing at Boston, in the county of Suffolk, State of Massachusetts, have invented certain Improvements in Telephone-Circuits, of which the following is a specification.

In systems of centralized or common current-supply for telephone-exchange circuits, wherein the battery or other source of supply is placed directly in the main-line circuit, the said source is usually introduced into the subscriber's circuit with the operator's telephone by the insertion of a connecting-plug into the socket of a calling-subscriber's line for the purpose of answering the call. This sudden introduction into the circuit of a considerable electromotive force and current produces in the subscriber's receiving-telephone a harsh rasping noise or click which most disagreeably and unpleasantly affects the ear of the user. In some systems of this class a battery of like magnitude to the talking-battery is normally connected with the sub-station circuit for the production therein of a signaling-current; and in such systems the said disagreeable click is accentuated, because it is due to two distinct but rapidly succeeding causes—viz., the sudden break of the original or signaling battery-circuit, and the sudden make of the working or talking battery circuit—and though two clicks really are made in the subscriber's telephone the second follows so closely upon the first that to the subscriber's ear the effect is that of a single but prolonged sharp and unpleasant rasping noise.

The object of our invention is to prevent or overcome this disagreeable click, which is heard by the subscriber as the operator plugs into the circuit; and this object is attained by providing that the electromotive force required for transmitter-supply shall be connected with the circuit before that employed for signaling is disconnected, so that momentarily the two electromotive forces are applied to the circuit in parallel with each other, and at no time therefore is the distribution of potential through the circuit materially disturbed. Thus in carrying out our invention as the answering-plug is inserted in the socket the transmitter or talking-battery is connected with the subscriber's circuit before the signaling-battery is withdrawn therefrom, and as the said plug is pushed fully into the socket the signaling-battery is disconnected. By adopting this plan of operation the connection of the talking-battery adds nothing to the difference of potential existing between the terminals of the circuit, nor does the subsequent withdrawal of the signaling-battery deduct anything therefrom.

The signaling and talking generators should be substantially alike in power and must be so connected that the currents they send to line shall be of like direction. This requirement permits of the use of a single generator for both purposes, and the invention therefore includes apparatus and circuit connections whereby such a single generator may conveniently be so employed. This practice is in the majority of cases preferable, and can be carried out by providing the said generator with distinct sets of terminals controlled by suitable switch devices, one set forming a signal-extension circuit or loop connected normally with the main-circuit terminals to maintain the resting or signaling instrument circuit and the other forming a telephone-circuit through the central-station telephones, being so placed and arranged that by the operation of the switch devices they may be connected with the main circuit in place of the first set to establish the talking-circuit, and vice versa, the said switch devices being so constructed that in making such transfer in either direction the circuit of the generator must be established through the second path before it is broken through the first.

Any of the well-known forms of switch may of course be employed in making the necessary circuit changes; but the plug-and-socket type, being in general use, is the form we employ in illustrating our invention, the socket or spring-jack being constructed to contain the main-circuit terminals and one set of the generator-terminals, while the other set of generator-terminals, forming a loop through the transmitter, are mounted on the plug portion of the switch.

More specifically, the plug-socket or spring-

jack in which the invention is embodied, in addition to two inner springs forming the normal-circuit terminals and pressing while the circuit is at rest upon the terminals of the signaling-generator, has two auxiliary contact-springs forming branch terminals of the two ends of the line-circuit, respectively, and projecting toward the front opening of the said socket. The connecting-plug is so modified that its rounded tip is made non-conducting, and it is constructed with two sleeve-conductors representing respectively the two conductors of the operator's answering-telephone and transmitter current generator, the said sleeve-conductors being insulated from one another and adapted to register with the two auxiliary or branch socket-springs, and thus to continue the line-circuit through the transmitter-battery as soon as the plug is inserted, while when the plug is pushed fully into the socket its rounded tip is enabled to lift the inner spring-terminals from their resting-contacts and thereby disconnect the normal signaling-generator.

In the drawings, Figure 1 is a diagram representing a circuit arranged on the old plan and involving the defect we seek to remedy. Figs. 2 and 3 are diagrams of a similar circuit embodying our invention and respectively showing the connections as they are, first, when the plug is partly inserted, and, second, when the plug is pushed fully into its socket.

Similar letters and figures of reference in the several views represent similar parts.

C represents a subscriber's-telephone circuit having two line-conductors L and L^2 extending between a sub-station A and a central station B. It is shown as being provided at the sub-station with the subscriber's automatic hook-switch N, a receiving-telephone T^2 and transmitter M^2, and at the central station with a plug-socket D containing the spring-jack connections J and a normal extension-circuit *b*, comprising the calling appliance or annunciator *a* and the signaling-generator S, which impresses upon the circuit a definite electromotive force, so that as soon as the circuit is closed at the sub-station in the usual way by removing the telephone from the hook the signaling-current may flow in the circuit and operate the annunciator *a*.

M is the transmitter and T the receiving-telephone of the operator at the central station B, and these are included, together with the generator of transmitting-current, in a normally-open station-circuit or extension-loop *d*, the two ends of which terminate in contact-surfaces p^2 and p^3 of the connecting-plug P, so that when a call comes in from the subscriber, manifesting itself by the fall of the annunciator-shutter, and is answered by inserting the plug P in the socket D, the contact-surfaces of the plug will register with the contact-springs of the jack J, and the main circuit C and the extension-loop *d* will be joined up into a single talking-circuit, including the telephones at both stations and the transmitter-generator S. The plug, in forming the new circuit through the operator's telephones and transmitter current generator, is also adapted to break the circuit through the signaling-battery and annunciator and to disconnect these appliances, which it does by means of its non-conducting rounded tip, which raises the terminal springs 2 and 3 from the fixed anvil-contacts *e f*.

In Fig. 1 the spring-jack connection J has the circuit-terminal springs 2 and 3 only, and these when at rest make contact with the signaling-generator terminals *e* and *f;* but on the insertion of the plug they make contact with the conducting-surfaces p^2 and p^3. The plug has a non-conducting handle portion, a conducting-tip p^2 of bulbous form, constituting the end of the conductor *g* of the answering-loop *d*, and a sleeve portion p^3, forming the terminal of the other wire *h* thereof, the said two conducting-surfaces being insulated from one another in the ordinary way by a ring and sleeve of non-conducting material.

When the plug P is first inserted in its socket D, its tip end raises the spring 2 from the point *f*, and thereby suddenly breaks the circuit of generator S. Being fully pushed in, the plug subsequently raises the other spring 3 from its resting-contact *e*, permits the said spring to make contact with its tip p^2, and establishes a second contact between the spring 2 and its sleeve-conductor p^3, whereby the transmitter-current generator *s* replaces in the circuit C the signaling-generator S. A sudden cessation of current necessarily occurs when the spring 2 is lifted from the point *f*, breaking the circuit of S, and a current is suddenly re-established when the two springs 2 and 3 make contact with the plug-surfaces, closing the circuit of *s*, and these abrupt changes produce a harsh and objectionable noise in the telephone T^2 at the sub-station, thus causing annoyance to the subscriber. In Figs. 2 and 3 this fault is prevented. The spring-jack connection is provided with two auxiliary contact-springs 4 and 5, which are branched from the main conductors L and L^2, respectively, and project farther forward than the original springs 2 and 3, which are now made both of the same length. The springs of both pairs are branch terminals of the circuit in parallel with each other, 2 and 3 being normally in contact with the signaling-battery terminals *e* and *f* and 4 and 5 being normally discontinuous branches.

The plug P is modified in structure, the bulbous tip *p* being made non-conducting, while the two conducting-surfaces p^2 and p^3 are now both portions of the sleeve, albeit separated from one another electrically by the insulating-ring *r*. p^2 may connect with the wire *g*, and p^3 with wire *h*.

The insertion of the plug P in its socket D, as shown in Fig. 2, to answer a call now first connects the two ends of the transmitter-current generator *s*, (represented by the plug-surfaces p^2 and p^3,) with the two ends of the

line-circuit C, as represented by the auxiliary springs 4 and 5, thus bringing into the circuit an additional generator parallel to the original one, and as the plug is forced fully into the socket then disconnects the said original generator S by bringing its non-conducting bulbous tip *p* between the ends of the inner spring-terminals 2 and 3, thus separating them from their respective resting-contacts *e* and *f*, which form the terminals of the said generator.

As already indicated, the preferred arrangement in practice is to employ a single generator, such as a battery, to furnish both signaling and talking currents, and this is indicated where in Fig. 2 the battery S is shown as being connected with the switch-plug surface-contacts by the conductors *x y*, (represented by dotted lines,) which unite with the poles of the said battery at the points *v* and *w* and with the terminal wires *g h* of the telephone-loop *d* at the points *m* and *n*. Since in this operation the signaling-generator is not disconnected from the line until the transmitter-generator is placed by its side in the line-circuit, its disconnection when effected produces no change in the electrical condition of the main circuit, and there is no noise in the subscriber's receiver. For the same reason no click is produced in the subscriber's telephone when the plug is withdrawn from the socket, the signaling-generator being in that case connected with the circuit before the transmitter-generator is disconnected therefrom.

The signaling and talking generators should be substantially alike in power, and must be so connected that the currents they send to line shall be of like direction.

We claim as our invention—

1. The combination of a telephone exchange circuit extending between a substation and a central station, and serving for the transmission of both signals and conversation; a signaling current generator normally in circuit therewith; and a transmitter current generator adapted for connection therewith during the transmission of speech; with a switching device, such as a plug, controlling terminals of said transmitter current generator and adapted to connect the same with said exchange circuit and subsequently to disconnect the signaling generator therefrom, substantially as described.

2. The combination of a main telephone circuit extending between a central and a substation; a signal extension circuit or loop at the former station containing a battery, and having its terminals normally united to the terminals of said main circuit to complete the same through signaling instruments; a telephone circuit extension containing the same or equivalent battery and the central station transmitter, normally detached from but adapted to connect with the said main circuit, and to form therewith a conversation circuit through the said transmitter; and switch devices controlling the terminals of the main and extension circuits, and adapted to transfer the connection of the main line from either extension to the other, and in each transfer to close the circuit of the battery through the second before breaking it through the first.

3. In a system of common or centralized battery telephone circuits, the combination of a main telephone circuit extending between a substation and a central station, having at the former a receiving telephone, and terminating at the latter in a plug socket containing a normal and an auxiliary contact spring, forming alternative terminals for each end of the circuit; a signal current battery normally connected with the said main circuit through the normal terminal springs thereof; a transmitter current battery adapted to replace said signaling current battery in the circuit during the operation of the telephone; and a switch plug controlling the terminals of said transmitter battery and adapted for insertion in the said socket and thereupon to first connect the said battery terminals with the auxiliary springs of the main circuit, and then sever the normal springs of the main circuit from the terminals of the signaling current battery, whereby the batteries may be exchanged on the insertion and withdrawal of said plug, without producing a disturbing noise in the substation telephone, substantially as described.

In testimony whereof we have signed our names to this specification, in the presence of two subscribing witnesses, this 3d day of July, 1895.

EDWARD SLADE.
JOHN S. STONE.

Witnesses:
GEO. WILLIS PIERCE,
JOSEPH A. GATELY.